Gravimagnetism

Horace Heffner December 9, 2004

CAUSALITY AND JEFIMENKO'S GRAVITY

In establishing his correspondence between gravity and the electromagnetic field, based primarily on causality and the effects of retardation, Jefimenko, in *Causality, Electromagnetism, and Gravity*, creates the correspondence of G to -1/(4*Pi*epsilon_g_0) to -mu_g_0*c^2/(4*Pi). The term epsilon_g_0 here is the gravitational equivalent to the electrostatic permittivity of the vacuum epsilon_0, and mu_g_0 is the equivalent to the magnetic permeability of the vacuum mu_0, as will be explained below. Jefimenko's version of EM fully accounts for causality, i.e. the fact that a cause at a distance d can not precede the effect by time delta t which is less than d/c (or d/c_g in the case of gravity.) Jefimenko shows that causality justifies invention of the co-gravitational field K, analogous to B. This will be shown below to make a full gravitational-electromagnetic field isomorphism possible. Jefimenko demonstrates that B, and thus K, are merely computed quantities, secondary quantities that necessarily follow from the only true causes, the interaction of charge upon charge or mass upon mass. This provides strong evidence for the "real" existence of K, as "real" as B, i.e. that an (apparent) K can be observed experimentally to the same extent B can, though it is much more difficult to observe due to the extreme orders of magnitude involved. In other words, if causal electromagnetism is correct, then the causal gravity is also necessarily correct. The isomorphism holds by necessity because the full set of postulates have already been experimentally verified. However, if it turns out that causal electromagnetism is incorrect, and B exists in a real sense, then it does not follow that K can (any longer) be assumed to exist on the basis that it is merely a computed quantity, like energy.

B and E are variable when the velocity of the observer is taken into account. This magnitude dependence on observer velocity is fully accounted for by causality treatment, because the relative velocity of the observer merely changes the apparent retardation. This aspect even more fully justifies Jefimenko's treatment of B as an artifact of charge motion.

In Jefimenko's text the world of gravity and electromagnetism are maintained as separate worlds, and merely corresponded to each other. Jefimenko thus uses epsilon_0 in the gravity context to mean -1/(4*Pi*G), and mu_0 to mean -4*Pi*G/c^2. He also uses c to mean the speed of propagation of gravity.

Here use the new notation epsilon_g_0 to mean the permittivity of space to gravity, mu_g_0 to mean permeability of space to co-gravity, and c_g to mean the speed of gravity propagation. So far there is really no change with the view of Jefimenko, only an extended notation. There are some immediate advantages to this notation, however. First it provides corresponding constants which could have been nicely used in the EM to gravity correspondences on page 104 of Jefimenko's book: *Causality, Electromagnetism, and Gravity*. Namely we could have the new Table 1, shown below.

Gravimagnetism

Horace Heffner December 9, 2004

Electric	Gravitational
q	m
E	g
B	K
J	J_g
epsilon_0	epsilon_g_0
mu_0	mu_g_0

Table 1: Initial Gravity-electromagnetism Isomorphism Correspondence Table

However, this is still not ideal. We have a problem with signs, as it appears did Jefimenko, but which he remedies by placing minus signs in the corresponding formulae. The problem lies in the fact that, to maintain the convention that a positive force is repelling, we end up with sign problems between the force equations:

$$Fg = G*(m1*m2/r)$$

for gravity and

$$Fe = k*(q1*q2/r^2) = (1/(4*Pi*epsilon_0))(q1*q2/r^2)$$

for the Coulomb force.

Jefimenko fixes this problem by making his epsilon_g_0 and mu_g_0 negative. Thus, in effect he has the gravitational equivalent to the above:

$$Fg = G*(m1*m2/r) = (-1/(4*Pi*epsilon_g_0))*(m1*m2/r^2)$$

His gravitational permittivity and co-gravitational permeability thus end up negative in order to preserve the correct sign on force. This eventually causes problems. An example is the Poynting vector correspondence:

$$S = (1/mu_0)\ E \times B$$

vs the Jefimenko gravitational version:

$$P = (c^2/(4*Pi*G))\ K \times g = (1/mu_g_0)\ K \times g$$

Note that Jefimenko here reverses K and G instead of using an arbitrarily placed minus sign.

It appears that there is a handy way out of this lack of true isomorphism. That solution is to specify the sign of the mass charge in terms of i = (-1)^(1/2), the imaginary number i. Charge has sign, so why not mass? This then makes the isomorphism complete. We now have

epsilon_g_0 = 1/(4*Pi*G)

mu_g_0 = 4*Pi*G/(c_g)^2

and all the formulae then exactly correspond, including signs. The disadvantage to this approach is that the imaginary number i must be carried throughout the gravitational field units. Perhaps this is really an unexpected advantage though. Gravitational fields are imaginary, electromagnetic are real. There is then some hidden meaning to this? One is that the two worlds ARE for the most part disconnected. We have in fact an indication of field *dis-unification*. Additionally we have that anti-gravitational matter, if it exists as implied by symmetry, would then carry sign (-i).

SPEED OF GRAVITY

Jefimenko adapts his theory to account for general relativistic effects by adjusting the speed of gravity. He notes (p. 135 ff.) that to account for the precession of the perihelion of Mercury, that the speed of propagation of gravity must be about 0.3 c. We thus have

c_g = 0.3 * c

and we know that

(c_g)^2 * epsilon_g_0 * mu_0_1 = 1

thus

(0.09 c^2) * epsilon_g_0 * mu_0_1 = 1

and we also have

mu_0 = (4/0.9)*Pi*G/c^2

Gravimagnetism

Horace Heffner December 9, 2004

We now have the full correspondence:

Electric	Gravitational
q	m * i
E	g
B	K
J	J_g
epsilon_0	epsilon_g_0 = 1.192602x10^9 kg s^2/m^3
mu_0	mu_g_0 = 1.037x10^-25 m/kg
c	c_g = = 8.99x10^7 m/s (Jefimenko's estimate)

Table 2: Gravity-electromagnetism Isomorphism Correspondence Table

where we now (roughly) know epsilon_g_0, mu_g_0, and c_g, and gravitational mass is expressed in terms of imaginary units i. J_g is mass current. Inertial mass everywhere in relativistic cases is the relativistic mass m0*gamma. We have a complete field isomorphism.

This isomorphism implies both a connection, as well as disconnection, between the electromagnetic and gravitational fields. We have achieved a form of "field dis-unification." The existence of i in some resulting equations distinctly and permanently isolates the purely gravitational fields and masses from electromagnetic components. We also now have computed fundamental constants: c_g, epsilon_g_0, and mu_g_0, as they must be according to Jefimenko's theory.

THE PROPOSED ISOMORPHISM IS NOT LIMITED TO JEFIMENKO'S VISION OF EM

Any complete theory of electromagnetism, including electromagnetism within the framework of relativity, can be used to create an isomorphism between electromagnetism and gravity, provided B in the theory is not real in the sense it is simply a byproduct of the other laws of the electromagnetic theory, and the electromagnetic vector potential function can be be derived from the (retarded) motion of charge. Jefimenko showed that the law of causality, if postulated, ensures that B meets this criteria. It is suggested here that the subject isomorphism can be established by first measuring or establishing the rate of propagation of gravity, c_g. We then can compute the permeability of space to co-gravity:

mu_g_0 = 4*Pi*G/(c_g)^2

and the permittivity of space to gravity:

epsilon_g_0 = 1/(4*Pi*G).

It is expected that c_g = c when full relativistic effects are applied, though, the ratio c/c_g is likley to change within close range to massive objects, due to the fact gravity and electromagnetism operate

in separate spacial dimensions.

We now establish the isomorphism by applying the following rules to every electromagnetic law in order to obtain corresponding gravitational laws.

Replace c, mu_0 and epsilon_0 with corresponding terms c_g, mu_g_0, and epsilon_g_0 above. Co-gravity K is defined as the gravitational equivalent to (corresponds under the isomorphism to) B, the magnetic field intensity B. Gravity g is defined as the gravitational equivalent of the electrostatic field E. Wherever charge is used, gravitational mass (gravitational charge) is substituted, with the sign of the charge removed (if ordinary matter is involved, i.e. not anti-gravitational matter) and replaced by the imaginary number i. J_g is the mass current vector corresponding to current density vector J.

When relativity is included, we then have the full correspondence:

Electric	Gravitational
q	m * i
E	g
B	K
J	J_g
epsilon_0	epsilon_g_0 = 1.192602x10^9 kg s^2/m^3
mu_0	mu_g_0 = 9.329597x10^-27 m/kg
c	c_g = c

Table 3: Gravity-electromagnetism Isomorphism Correspondence Table

NOTATION AND NOMENCLATURE RELATED TO GRAVITATION

The EM-GK isomorphism provides analogs to a vast quantity of physical laws, formulae and terms. This can cause much confusion in the process of attempting to assign names and symbols the gravitational analog items.

To be consistent, and end terminology confusion, when discussing or expanding the isomorphism proposed here between the electromagnetic (EM) and gravikinetic (GK) fields, when referring to a gravitational feature the analogous term borrowed from the EM universe should be prefixed with "gravi" to indicate that that analogous feature is in the GK universe. If it is not appropriate to prefix a term with "gravi" then it can be preceded with the adjective "gravitational".

Under the proposed EM-GK isomorphism every variable, every formula, every unit in EM has a corresponding value, a gravitational analog. The formulas and variables from the EM world should be used faithfully, and simply subscripted where necessary with a g to designate the GK analog.

The exceptions to these rules are the variables g, and G, and co-gravitational field K, which is

hereby now called the gravimagnetic field K, which are symbols that already have specific meanings.

Based on the above principles, the following are sample correspondences:

```
electrostatic field E:     gravitational field g
magnetic field B:          gravimagnetic field K
electromagnetic (EM) :     gravikinetic (GK)   (a necessary rule exception)
charge:      gravicharge (an imaginary quantity in units of +i kg, or possibly -i kg, not to
be confused with mass)
current:     gravicurrent (an imaginary quantity in units of +i kg/s)
magnet:      gravimagnet
monopole:    gravimonopole
Poynting vector P:    gravitational Poynting vector P_g
ohm (omega):         graviohm (omega_g)
permittivity (epsilon) :     gravipermittivity (epsilon_g)
permeability (mu) :          gravipermeability (mu_g)
lightspeed (c):              gravispeed (c_g)
impedance of the vacuum (nu):  graviimpedence of the vacuum (nu_g)
Maxwell's laws of electromagnetism:  Maxwell's laws of gravimagnetism
Gauss' Law of electric flux:  Gauss' Law of gravitational flux
Laplace's Law of Electrostatic potential:   Laplace's Law of Gravitational Potential
```

Similar terminology should be used when applied to the laws of Lenz, Biot-Savart, Ampere, Ohm, etc. The theory itself, the EM-GK Isomorphic Theory, can thus simply be called a theory of gravimagnetism.

This approach to nomenclature puts an end to the need for all kinds of special terms and variables. Also, when the meaning is clear, one can simply dispense with the g subscripts, and thus incur no notation overhead whatsoever. Note that this approach would not work well if the isomorphism were not complete.